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| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/715,019   | 11/17/2003  | Gabriele Fichtl      | P20001,0387         | 3283             |
| 24131  | 7590        | 06/15/2004           |                     | EXAMINER         |
| LERNER AND GREENBERG, PA<br>P O BOX 2480<br>HOLLYWOOD, FL 33022-2480 |             |                      |                     | HUYNH, ANDY      |
|  |             |                      | ART UNIT            | PAPER NUMBER     |
|  |             |                      | 2818                |                  |

DATE MAILED: 06/15/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

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|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 10/715,019             | FICHTL ET AL.       |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | Andy Huynh             | 2818                |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on 17 November 2003.  
 2a) This action is FINAL.                    2b) This action is non-final.  
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1-13 is/are pending in the application.  
 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) Claim(s) \_\_\_\_\_ is/are allowed.  
 6) Claim(s) 1-13 is/are rejected.  
 7) Claim(s) \_\_\_\_\_ is/are objected to.  
 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.  
 10) The drawing(s) filed on 17 November 2003 is/are: a) accepted or b) objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
 1. Certified copies of the priority documents have been received.  
 2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- 1) Notice of References Cited (PTO-892)  
 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)  
 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
     Paper No(s)/Mail Date 11/17/03.
- 4) Interview Summary (PTO-413)  
     Paper No(s)/Mail Date. \_\_\_\_\_.  
 5) Notice of Informal Patent Application (PTO-152)  
 6) Other: \_\_\_\_\_.

## **DETAILED ACTION**

Claims 1-13 are pending in the application, which is a continuation of copending International Application No. PCT/EP02/06090 filed June 3, 2002, is acknowledged.

### ***Priority***

Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d) based on an application filed in EPO 01113838.5 on 06/06/2001.

### ***Information Disclosure Statement***

This office acknowledges receipt of the following items from the applicant: Information Disclosure Statement (IDS) filed on November 17, 2003. The references cited on the PTOL 1449 form have been considered.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3-5, 9 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hieda et al. (USP: 5,998,821 hereinafter referred to as "Hieda"), Applicant submitted prior art (ASPA), in view of Liu et al. (USP: 6,458,671 hereinafter referred to as "Liu"), and further in

view of Komura et al. (USP: 5,423,941 hereinafter referred to as “Komura”), Applicant submitted prior art (ASPA).

Regarding claim 1, Hieda discloses in Figs. 5-7 and related texts as set forth in column 4, line 36-column 9, line 16, a method for manufacturing a trench capacitor having an isolation trench, which comprises:

forming a trench capacitor in a trench (12) (col. 4, line 51) of a semiconductor substrate (21) (col. 4, line 48), the trench capacitor having:

a lower part formed with an outer electrode (23) (col. 4, lines 53-54), an inner electrode/a polysilicon film (25) (col. 5, lines 4-5), and a dielectric/a node dielectric film (24) (col. 4, line 59) between said inner and outer electrodes;

an upper part formed with a collar isolation/a collar oxide (53) (Fig. 5, col. 7, lines 57-58) on sidewalls of the trench;

wherein a silicon layer/a epitaxial Si layer (28) (Fig. 5, col. 8, line 39) covers the trench capacitor on top of the collar isolation and a hard mask/a mask layer (54, 55) (Fig. 6A, col. 8, lines 56-57) covers the silicon layer; and the method further comprises:

opening the hard mask to reach a surface of the silicon layer/the epitaxial Si layer (Fig. 6A).

Hieda fails to teach in a first etching step, dry etching with an etching gas comprising chlorine or bromine until the collar isolation is reached; and in a second etching step, dry etching with an etching gas comprising silicon fluoride and oxygen.

Liu teaches in Fig. 3A-3D that a method of forming a shallow trench within a trench capacitor structure comprises two plasma etching steps. In the first etching step, a plasma source

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gas containing Cl<sub>2</sub>, HBr and O<sub>2</sub> is used (col. 5, lines 29-30), and the trench then etched down to oxide regions (314) (Fig. 3C, col. 4, lines 48-51). In the second etching step, a plasma source gas comprises a noble gas and a halocarbon, or CF<sub>4</sub> and Ar. In some cases, the plasma source gas further comprises CHF<sub>3</sub> (col. 2, lines 18-26).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to utilize two plasma etching steps to form a shallow trench within a trench capacitor structure, as taught by Liu in order to provide a shallow trench, which can function as an isolation trench, with a substantially flat trench bottom, while at the same time providing greater flexibility with respect to etch profile as set forth in column 2, lines 39-44.

Liu fails to teach in a second etching step, dry etching with an etching gas comprising silicon fluoride and oxygen.

However, Komura teaches that an etching gas mixture comprising SiF<sub>4</sub> and O<sub>2</sub> was used in a process of forming a trench by dry etching of Si (col. 4, lines 23-25). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to use the etching gas mixture comprises SiF<sub>4</sub> and O<sub>2</sub> in a process of forming a trench by dry etching of Si, as taught by Komura to improve the selectivity ratio against SiO<sub>2</sub> and provide deep trenches, with a good reproducibility and with a good configuration (col. 2, lines 54-56).

Regarding claim 3, Hieda discloses the claimed limitations except for the method according to claim 1, wherein the etching gas in the first step comprises hydrogen bromine gas and at least one of the gases helium and oxygen. Liu teaches that the first plasma etching step can be conducted using a plasma source gas that comprises HBr and O<sub>2</sub> as set forth in column 2, lines 10-12. It would have been obvious to one of ordinary skill in the art at the time of the

invention was made to use the etching gas in the first step comprises hydrogen bromine gas and at least one of the gases helium and oxygen, as taught by Liu to provide greater flexibility with respect to etch profile (col. 2, lines 42-43).

Regarding claims **4 and 5**, Hieda discloses the claimed limitations except for the method wherein the etching gas in the second step further comprises argon gas, and further comprises CF<sub>4</sub>. Liu teaches that the second plasma etching step can be conducted using a plasma source gas that comprises CF<sub>4</sub> and Ar (col. 2, lines 22-24). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to use the etching gas in the first step comprises hydrogen bromine gas and at least one of the gases helium and oxygen, as taught by Liu to provide greater flexibility with respect to etch profile (col. 2, lines 42-43).

Regarding claim **9**, Hieda, Liu, and Komura disclose the claimed limitations except for the method according to claim **1**, which comprises starting the second etching step after performing the first step during a predetermined time period. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to determine a predetermine time period for starting the second etching step after performing the first step, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim **11**, Hieda discloses the method according to claim **1**, wherein the hard mask comprises silicon oxide (col. 8, lines 56-57).

Regarding claim **12**, Hieda discloses the method according to claim **1**, wherein the collar isolation/the collar oxide comprises silicon oxide (col. 7, lines 57-58).

Regarding claim 13, Hieda discloses in Figs. 5-7 the method according to claim 1, which comprises forming in the semiconductor substrate (21) at least two closely adjacent trench capacitors (23, 24, 25) having a collar isolation/a collar oxide (53) (Fig. 5, col. 7, lines 57-58) and forming the hard mask/the mask layer (54, 55) (Fig. 6A, col. 8, lines 56-57) relative to the at least two trench capacitors so that portions of the collar isolations facing each other are etched during the second etching step and in that portions of the collar isolations that are not facing each other are maintained during the second etching step (Fig. 7A).

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hieda et al. (USP: 5,998,821 hereinafter referred to as “Hieda”), in view of Liu et al. (USP: 6,458,671 hereinafter referred to as “Liu”), and in view of Komura et al. (USP: 5,423,941 hereinafter referred to as “Komura”), and further in view of Sasaki et al. (USP: 6,669,855 hereinafter referred to as “Sasaki”).

Hieda, Liu, and Komura disclose the claimed limitations except for the method according to claim 1, wherein the etching gas in the first step comprises hydrogen chlorine gas and at least one of the gases helium and oxygen. Sasaki teaches that in the etching process with RIE, the etching gas contains at least one of hydrogen chloride (HCl) with oxygen (O<sub>2</sub>) (col. 11, line 65-col. 12, line 3). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to use at least one of hydrogen chloride (HCl) with oxygen (O<sub>2</sub>) as etching gas, as taught by Sasaki in order to complete the etching process with RIE in a short time (col. 12, lines 4-5).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hieda et al. (USP: 5,998,821 hereinafter referred to as “Hieda”), in view of Liu et al. (USP: 6,458,671 hereinafter referred to as “Liu”), and in view of Komura et al. (USP: 5,423,941 hereinafter referred to as “Komura”), and further in view of Peinador et al. (USP: 6,669,855 hereinafter referred to as “Peinador”).

Hieda, Liu, and Komura disclose the claimed limitations except for the method according to claim 1, which comprises terminating the first etching step and starting the second etching step when, during the first step, a by-product generated from the oxide isolation is detected. Peinador teaches that plasma etching is a well-known dry etching process in the art of semiconductor fabrication. It is also known that the endpoint of a plasma etching process may be determined by monitoring the level of emission of selected byproducts of the etching reaction. For example, an endpoint detector may be used for detecting byproducts of the etched layer in the exhaust stream of the etching chamber as set forth in column 1, lines 10-18. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to include terminating the first etching step and starting the second etching step when, during the first step, a by-product generated from the oxide isolation is detected since it was known in the art that is used to control the etching process by detecting byproducts.

Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hieda et al. (USP: 5,998,821 hereinafter referred to as “Hieda”), in view of Liu et al. (USP: 6,458,671 hereinafter referred to as “Liu”), and in view of Komura et al. (USP: 5,423,941 hereinafter referred to as “Komura”), and further in view of Howald (USP: 6,400,458).

Hieda, Liu, and Komura disclose the claimed limitations except for the method according to claim 1, which comprises terminating the first etching step and starting the second signal obtained from a etching step in response to a measurement employing interferometry or optical emission spectroscopy. Howald teaches that common methods for monitoring the etch process and determining the endpoint include spectroscopy and interferometry, and it would be desirable to be able to detect interferometric signals from a wafer being etched as set forth in column 1, lines 22-24, and column 2, lines 44-45. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to utilize the spectroscopy and interferometry methods for monitoring the etch process and determining the endpoint by detecting signals from a wafer being etched, as taught by Howald since it was known in the art that spectroscopy and interferometry methods are common methods for monitoring the etch process and determining the endpoint.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hieda et al. (USP: 5,998,821 hereinafter referred to as “Hieda”), in view of Liu et al. (USP: 6,458,671 hereinafter referred to as “Liu”), and in view of Komura et al. (USP: 5,423,941 hereinafter referred to as “Komura”), and further in view of Koburger (USP: 6,503,813).

Hieda, Liu, and Komura disclose the claimed limitations except for the method according to claim 1, wherein the hard mask comprises boron silicate glass. Koburger teaches that a hard mask such as BSG is an erosion resistant material as set forth in column 4, lines 38-40. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to use

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BSG as a hard mask, as taught by Koburger since it was known in the art that the BSG is an erosion resistant material, and is useful in the etching processes.

***Conclusion***

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andy Huynh, (571) 272-1781. The examiner can normally be reached on Monday-Friday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The Fax number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the -status of this application or proceeding should be directed to the receptionist whose phone number is (703) 308-0956.



AH

Andy Huynh

June 2, 2004

Patent Examiner